

Modern Initial Management of Severe Limbs Trauma in War Surgery: “Orthopaedic Damage Control”

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ABSTRACT

The severe open limbs traumas are very frequent in modern wars. The conditions of local management of the casualties are most of the time very “rustic” and associated with extra difficulties: Mass cal context, surgical tools and competences limited, soldiers badly injured....A classic management is most of the time impossible to realise. The authors proposed to use a new philosophy of first management of these lesions: “The Orthopaedic Damage Control”. After a short presentation of the concept they give their own experience of this kind of management in civilian practice and discuss the possibility to extend it to war surgery in role 1 and role 2.

1.0 INTRODUCTION

The “body armor” and other tactical vest realise a relative protection of the torso neck and groin for the modern soldiers. The upper and lower limbs are unprotected by this kind of devices and the majority of the injured soldiers in Iraq and Afghanistan get severe limbs traumas. The management of this kind of injuries is time consuming and material dependent. A quick surgical initial procedure is most of the time required and necessary. The “Orthopaedic Damage Control” ODC defined the basic concept of this philosophy.

2.0 MATERIAL AND METHOD

2.1 Definition of “Orthopaedic Damage Control”

The Damage Control is a civilian naval procedure used in case of impending naval danger. In case of risk of shipwreck the captain ask to the crew to participate to the “damage control”. Also all the people on the ship stop what they were doing and try to save the boat. The philosophy explains why this term has been chosen to indicate a new kind of surgical management for the most serious cases. The first use of the concept of Damage Control in surgery was invented in visceral surgery [1] to indicate a special kind of management for the most severe abdominal and thoracic injuries in civilian practice to avoid surgical lethal complications by a shortened surgical management. Haemostasis, thoracic drainage and abdominal fluid controlled is the initial treatment in order not to have any coagulation problem. The final and complete definitive surgical procedure is realised secondarily after resuscitation. Some years after this concept has been extended to the orthopaedic surgery [2,3]. In case of severe upper or lower limbs injuries necessitating a long surgical management impossible to realise for many reasons (Brain injury [4,5] without brain pressure monitoring, Mass cal, Intensive Care or Orthopaedic or Surgical devices and surrounding imperious).

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2.2 Technique

The philosophy of the ODC is to realise an approximate reduction, a fast immobilisation by an external fixation device to avoid fat embolism, allow an optimal nursing and medical evacuation without any secondary functional consequences [3].

2.2.1 Indications: The Different Imperious

Intensive Care Imperious:

Associated unstable thoraco-abdominal injuries, unstable brain injuries, multiple orthopaedic injuries.

Orthopaedic Imperious:

Multiple open shaft fractures with blood loss, complex epiphysal fractures requiring a long difficult surgical bloody procedure, unforeseeable subsequent cutaneous associated lesion development.

Orthopaedic Devices imperious:

Very special surgical orthopaedic material not immediately available.

Surrounding imperious:

Loneliness surgical activity, Disaster context, Mass cal.

2.2.2 Surgical Tools: External Fixation Device [6]

The surgical tools must be simple stiff enough to maintain the reduction with pins adaptable to most of the different external fixation pins used all over the world in order to allow the second surgical procedure after MEDEVAC without the necessity to remove the initial pins. The monolateral external fixation device offers all these characteristics. Because it is stiff enough single use radiolucent amagnetic cheap simple very adaptable and realised with the NATO STANAG external fixation device we use Mono-lateral External Fixation Device : Percy fx® from Depuy Company (Johnson & Johnson). This is the official external fixation device of French Military Health Service. The use of external fixation must be limited when the use of simple “open caste” cannot be proposed : severe limbs injuries with comminuted unstable fractures, open fractures with soft tissue damage, articular severe fracture, simple multiple shaft unstable closed fracture [6,7].

2.2.3 Technical Management

After an approximate reduction, the fracture can be secured by the Percy fx ® with few pins on each side, to bridge the fracture. The articulations are bridged without remorse. Area of implantation of pins can be “non classic” in order to immobilize the faster as possible. For example a shaft femoral fracture can be immobilized by a trans-quadriceptal external fixation device for some days and secondarily removed for intra-medullary nailing [7,8,9]. The number of pins must be fewest as possible but the setting must be stiff enough to avoid extra-mobility and allow MEDEVAC with casualty comfort.

3.0 SERIES

Between 2003 and 2009 four patients have been managed with an ODC procedure in the Teaching Naval Hospital St Anne in Toulon after civilian traumatic injury. They were all males. The mean age was 23 years old (16yo to 34). They were all traffic accidents with motorcycles in context of high velocity injuries. The reasons which justify the choice of ODC procedure are reported in table N° 1. The first surgical procedure was realized in emergency the reduction was maintained by Percy fx®. The mean

duration between primitive and final procedure was 6 days (3 to 10 days). The location of injuries was electively the lower limb and the femur 3 times.

Table 1: Presentation of the series.

CASES	Sex Age	Initial injury Checking	Reason of Damage Control Procedure
Patient 1	♂ 17	MA/ Brain Trauma, wrists articular F, Femur shaft F, ankle F	Extra-dural haematoma without possibility of monitoring
Patient 2	♂ 25	MA/ Left leg open F Gustillo level IIIa [4]	Skin unforeseeable damage
Patient 3	♂ 34	MA/ Left lower limb articular communited F with floating knee Gustillo level II	Specific Material non avaluable in emergency. Skin unforeseeable damage
Patient 4	♂ 16	MA/ Femur Shaft F with soft tissue damage on the surgical approached for nailing.	Skin damage on the trochanteric approached for nailing

MA: Motorcycle Accident, F: Fracture

4.0 RESULTS

All the bone injuries healed without any bone mal-union. Full weight bearing was allowed 3 months after surgery. Three cases healed with infection but without story of pseudarthrosis. After surgical identification of the microbes an adjust antibiotherapy was performed during 3 months with good results. It was not necessary to realize a third surgical procedure for infection. All the results are reported into the Table N°2.

Table 2: Final results.

CASES	INITIAL TREATMENT AND DURATION OF SURGICAL PROCEDURE	FINAL TREATMENT	DELAY	FINAL EVOLUTION
Patient 1	Femur MLEF wrist and ankle cast. 60 mn	ORIF	3 days	Bone healing without infection and mal union
Patient 2	Leg MLEF and soft tissue debridement. 35mn	Intra-Medullar Nailing	6 days	Bone healing with infection
Patient 3	MLEF bridging the knee. Debridement 45mn	ORIF and retrograde Nailing	10 days	Bone healing with infection and stiffness
Patient 4	MLEF and soft tissue debridement 35mn	ORIF	5 days	Bone healing with infection

MLEF: Mono Lateral External Fixation, ORIF: Open reduction Internal Fixation.

5.0 DISCUSSION

Limbs injuries are very frequent during war time and become the majority of casualties. The generalisation of the explosive devices set of in crowded area increases the number of casualties. The context of mass cal is frequent in these conditions. So the surgical capability of role 1 and role 2 hospitals can be quickly overwhelmed. The philosophy of “surgical damage control” has been created by visceral surgeons for the treatment of the most severe torso injuries in order to decrease the morbidity of a traditional surgical management [1]. The goal is not to treat every visceral and vascular injuries but to close the “blood tape” and realize in emergency a urine and digestive fluid derivation. For orthopaedic surgery the goal is to treat the maximum of casualties in the minimum of time without creating extra-surgical damage for a future complete rehabilitation [2,3]. The context of mass cal with a majority of limbs traumas in surgical rustic conditions makes the damage control a real interesting surgical tool.

Our short series is interesting for many reasons. First the time of initial bone reduction, soft tissue debridement and fracture fixation is really short, second the definitive surgical treatment was possible in every cases without any trouble except infection. Last but not least the bone and soft tissue healing was obtained in every cases. 75% of cases healed with infection. Isn’t it a complication of external fixation? [10] It is possible but the three cases with infection were developed after open fracture in context of high velocity injuries. Bird and coll insisted on the relationship between the violence of trauma and the risk of infection. Many publications insist on the high frequency of bone infection after external fixation in relation of usual local pins infection [10,11]. So it is impossible in this short series to identify the real cause of infection. Last but not least, the supervision of initial soft tissue unforeseeable damage was easy and flap covering was not necessary secondarily.

Nevertheless, the external fixation device is for us a real necessary tool. Indeed, if a plaster immobilisation is a good waiting solution for a wrist or an ankle closed fracture it is not stiff enough for legs or femur and doesn't allow the soft tissue injuries management and supervision. The mono-lateral external fixation is simple in accordance of the rustic condition of war time surgery. More, the whole treatment can be realised with this device until bone healing and the soft tissue injury management can be easily done. The Percy fx ® is made of Carbone and plastic so the set is very light. It is possible to transport many sets by plane. The pins of this device had been created to be adaptable to every type of mono-lateral external fixation device sale all over the world. This characteristic allows the complete change of the device except the pins in role 3 hospital after MEDEVAC if necessary and appears as a real advantage in context of multinational military overseas deployment. The pins are designed to be inserted directly with a surgical drill into the bone without early perforation, so the duration of insertion is much shortened.

Is ODC an interesting tool in war surgery? War surgery in role 1 must be fast and secure. The goal of the initial management of the limb injuries is: Vascular lesions control, soft tissue damage exploration and debridement, bone reduction and fixation. The anatomic reduction is not initially mandatory. The challenge is to save the life of the casualty and set him in the best conditions for medical evacuation. All these constraints can be complicated to achieve in case of mass cal. The ODC allows vascular injury management and soft tissue debridement at the same time a shortened bone fixation. So the philosophies of ODC and war surgery are supplementary. We can consider that the ODC is a interesting tool in war surgery especially in case of Mass Cal.

6.0 CONCLUSION

The increasing frequency of mangled extremity in war surgery during the modern conflict appears as a difficult challenge for orthopaedic and traumas surgeons deployed in role 1 facility. The context of Mass Cal adds an extra difficulty for the initial treatment of the casualties. The ODC offers to the surgical team the opportunity to manage very fast the maximum of wounded soldiers in order to allow their MEDEVAC with the best conditions without to darken the final functional prognosis. For these reasons we thing that the “Orthopaedic Damage Control” can be consider as a real interesting tool in war time.



Figure 1: Initial X Ray of patient 1.

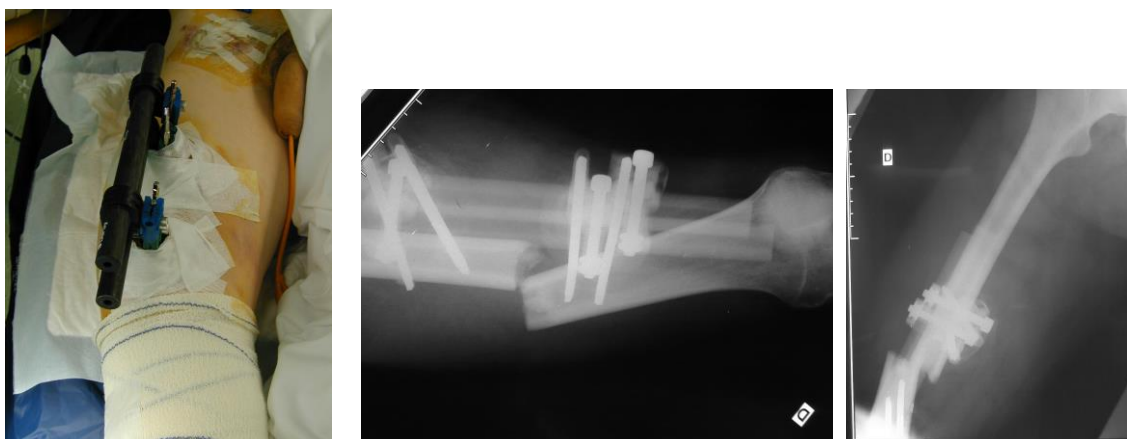


Figure 2: External fixation of the femur patient 1.

The Percy fx® was positioned through the quadriceps in order to reduce time of reduction and insertion also to put the pins in a soft tissue trajectory far away from the lateral surgical approach for ORIF. The reduction is far from perfect but the device was stiff enough to prevent extra-mobility and decrease the risk of fat embolism.

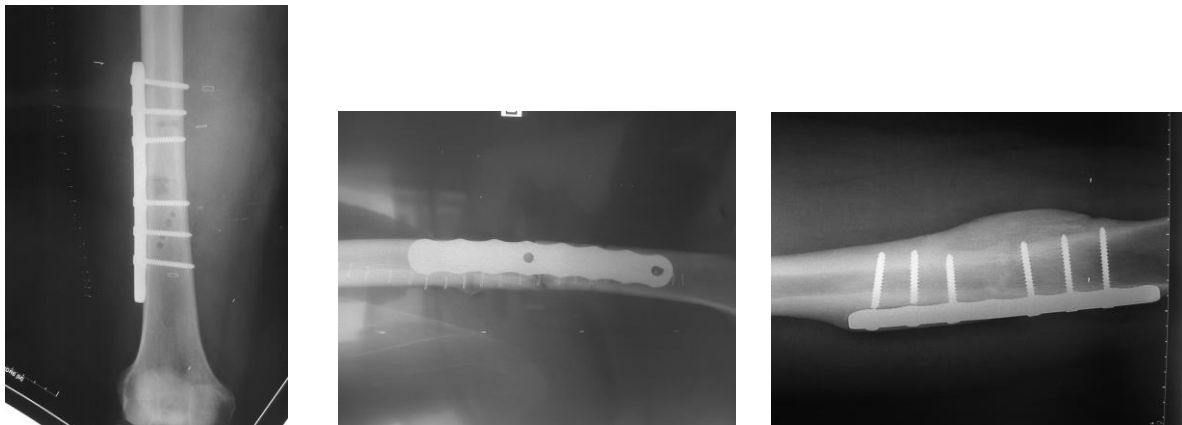


Figure 3: Final X Ray patient 1.

X Ray just after plating 5 days after injury frontal and lateral view and after bone healing. The surgical approach was realized by a lateral one in order to be far away from potentially initial pins trajectories.

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